ARPA-E's 37 Projects Selected From Funding Opportunity Announcement #1

Project Title:	High Energy Permanent Magnets for Hybrid Vehicles and Alternative Energy
Organization:	University of Delaware
Funding Amount:	$4,475,417
Website:	www.Udel.edu

Brief Description of Project

The goal of this project is to develop materials with properties better than $Nd_2Fe_{14}B$ (the world's strongest magnet) that will allow us to fabricate the next generation of permanent magnets with magnetic energy density (maximum energy product) much higher than the current value of the strongest Nd-Fe-B magnets (59 MGOe) approaching the theoretically predicted value of 100 MGOe. The following three different routes will be employed for the development of these materials. The ***first route*** will be aimed at discovering new materials with high anisotropy and high saturation magnetization in ternary rare earth (RE) - transition metal (TM) - element X systems (X = Li, Mg, P, S, As, Se, Sb, Te, F, Cl, Br, or Zn), which have not yet been explored. The ***second route*** will be aimed at the development of RE-free high anisotropy and high magnetization compounds in doped Fe-, Co- or Mn-rich materials. The ***third route*** will be aimed at the development of high-energy exchange-coupled anisotropic nanocomposite materials via the bottom-up approach using magnetically hard anisotropic nanoparticles of existing ($SmCo_5$, $Nd_2Fe_{14}B$, $Sm_2Fe_{17}N_x$) or the newly discovered compounds and the high saturation magnetization of the magnetically soft Fe-Co nanoparticles.

Why ARPA-E Funding and Not Private Capital

There are several reasons why this project should be supported by ARPA-E and not by Private Capital: 1) this program is of national interest to our economy and defense 2) it is a high risk, high reward project and therefore not attractive to private capital 3) most magnet producers have moved to the Far East and government must invest in research/development/technology to revive the field and 4) the proposed project is closer to basic science and is not ready yet for development.

Uniqueness/Benefits of Technology

The proposed research and development will provide the fundamental innovations and breakthroughs which will have a major impact in re-establishing the United States as a leader in the science, technology and commercialization of this very important class of materials and help decrease our dependence on China. Furthermore, this high-risk project, if successful, will lead to lower cost more efficient energy and power dense devices that will result in a substantial reduction in our nation's dependence upon foreign sources of fossil fuels.

Addressable Market & Potential Customers

These magnets are indispensable for many applications in electric, electronic and automobile industries, communications, information technologies and automatic control engineering and directly affect their energy efficiency. Currently the demand for these magnets is even higher with the emerging markets of hybrid/electric vehicles, wind mill power systems, more economical and environmentally friendly transportation systems, power generation systems and energy storage systems. Current market size is over $7 billion and is expected to grow to $14 billion by 2020.

For inquiries, contact:

Email:

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Website:

http://arpa-e.energy.gov/

Key Team Member Bios

George C. Hadjipanayis serves as the Chair for the Department of Physics and Astronomy at the University of Delaware, where he holds the appointment of Richard B. Murray Professor of Physics. He is a world renowned expert on magnetic materials and especially on nanoparticles and modern permanent magnets. He has more than 500 publications in the field of magnets.

David J. Sellmyer is the George Holmes University Distinguished Professor in the Department of Physics and Astronomy at the University of Nebraska, and the Director of Nebraska Center for Materials and Nanoscience. He has 40 years experience in magnetic materials and over 480 publications.

R.William McCallum is a Senior Materials Scientist in Ames Laboratory, at Iowa State University with over 30 years of experience in the synthesis and characterization of magnets.

Vincent Harris holds the William Lincoln Smith Chair Professor in the Electrical and Computer Engineering Department at Northeastern University. He has had a distinguished career as an engineer, scientist, inventor, and entrepreneur for more than 20 years.

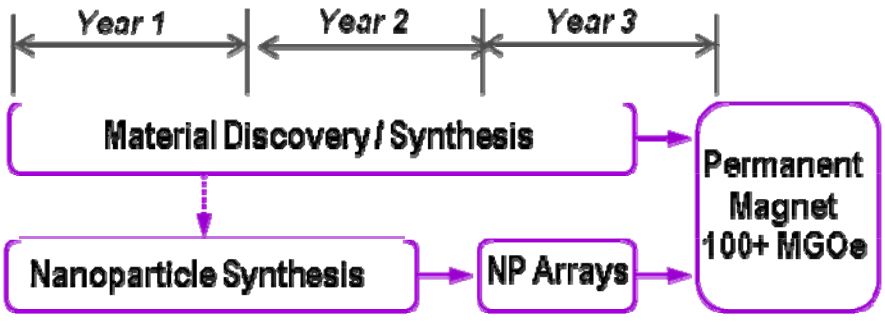
Everett Carpenter is an inorganic chemist with a strong background in the synthesis and characterization of nanoparticles. Currently, he is the Director of Nanoscience and Nanotechnology Program at VCU.

JinFang Liu is currently the EEC Vice President of Technology and Engineering. He has been involved in the science and technology of permanent magnets for the past 25 years.

Miscellaneous

Potential customers will include the current customers of EEC and those who currently use Nd-Fe-B magnets. Some of the main companies are General Electric (and their subsidiaries), Northrop Grumman, Teledyne, L3 Communications and those related to wind power generation and hybrid/electric vehicles.

Schematics/Photos of Technology or Personnel



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